3.3 GENERAL POPULATION EXPOSURE ESTIMATES

The purpose of this general population exposure assessment is to determine non-occupational exposures to lithography blanket wash chemicals. This determination addresses contact by people who are not directly involved in the lithography process. People who live near a printing facility may breathe air containing small amounts of vapors from evaporation of products at the printing facility. Residues from the blanket wash products enter the environment when facilities, either printer facilities or laundries washing the rags, discharge the products down the drain, either to a publicly-owned treatment works (POTW) or through a septic system. Once the chemicals enter surface water, they may travel downstream and enter a drinking water facility. People could then be exposed by drinking this water. People may also drink well water that contains contaminants that have migrated from a landfill where wastes, especially rags and empty containers, are disposed. For each of these contact routes, the amount of exposure depends on several factors: distance from the facility, the actual routes of contact (such as drinking, breathing, touching), the length of time the chemical has been in the environment, and the way that the chemical moves through the environment. The potential exposures also depend on environmental conditions, including the weather and the volume of water in the stream or river which receives the facility's discharges.

The general population exposure assessment should not be compared to the occupational health standards to determine if an exposure is reasonable or not. Many occupational standards are based on technological feasibility, rather than ideal risk reduction. Furthermore, measuring internal facility contaminant levels may not be sufficient to determine significant general population exposure. Certain types of controls simply move the chemical from inside the plant to the outdoors, creating higher concentrations outside the facility than inside the facility. Some pathways of exposure, such as the drinking water path, do not exist for workers. It is also important to note that some chemicals may have a more significant impact on a specific segment of the general population, such as children, than on a typical worker.

Chapter 2 contains summaries for the fate of all of the chemicals identified as being used in blanket wash products. The fate of the chemical in the environment is how we refer to the breakdown (transformation) and mobility of the chemical through air, water, and land. Chemical fate differs for release through a waste water treatment facility as opposed to an air release or a landfill release. Definitions of the terms used to describe the fate are also included in Chapter 2. For this assessment, the percent removal during wastewater treatment and the half-life of the chemical in air are the primary elements taken from the fate assessment.   The other properties and processes listed were used to derive or estimate these values.

This assessment addresses two perspectives: local and regional. The local point of view considers a single facility in normal operation. It will have certain releases that affect a specific area and specific local population. Since information is not available for each lithography facility, a "model facility" approach is used to calculate typical releases and environmental concentrations. This approach will not allow us to specify the number of people around the facility because the population varies considerably depending on the location of the printing facility. The regional perspective provides insight into the overall impact of releases from all of the printing facilities for the general population. While one facility may not be releasing very much of any given chemical, the cumulative effect of all of the printers in an area could be serious. The regional perspective was modeled using facilities located in a single city, Denver, Colorado, to provide an example of cumulative exposures.

This exposure assessment should be used in conjunction with the health assessment to provide a balanced picture of risk. The specific effects of a chemical, such as acute (short-term) effects or chronic (long-term) effects, determine what period(s) of exposure to consider. For long-term (chronic) effects, such as carcinogenicity, it is most helpful to have average, or typical,

exposures, since the effect depends on the cumulative exposure. For acute effects, which can include things such as eye irritation, a peak exposure estimate would be more helpful. This can then be compared with levels at which the chemical is known to cause immediate health problems. Since the information which would allow peak exposures to be calculated is not available, average concentrations are calculated in this assessment.

Uncertainty

Estimating exposures is a science where many pieces are approximated, leading to some uncertainty in the results of the estimates. In this assessment we used a model facility approach, where the model facility was not an actual printing facility which exists.   In our modeling, we have fixed certain data points to specific values. Although we have previously used weather data specifically for San Bernardino, this does not mean that the concentration results have no meaning for a different location. Many locations would have roughly the same concentration results as San Bernardino, and no locations would have concentrations of less than one tenth of the results for San Bernardino. Often, data parameters are fixed because we know what selecting this combination of values does to the relative value of the risk. The building height, temperature and the exit velocity in air modeling are examples of these types of parameters. We have set them to maximize the average concentrations close to the facility.   Some people would call this a worst case, or a bounding estimate. In actuality, since we have presented a scenario for modeling, but do not know how often those exposure levels (or, potential doses) actually exist, the exposure estimates should be labeled a "What if."   These What if estimates answer a question similar to "What happens if the building is always three meters tall, the air escaping has little exit velocity, and is ambient temperature?" It is a very good basis for comparing risk between formulations.

Overview by Media

The following sections provide an overview of general population exposures that may occur via air, surface water, septic systems, and landfills.

Air

Local Exposure: Releases to air result from evaporation of chemicals during the blanket wash process.   Activities include allowing blankets to dry, using shop towels during blanket cleaning, or opening the containers that hold the blanket wash. These vapors are then carried by and mixed with outside air. The resulting air concentration will depend on weather conditions. Stagnant conditions will not move vapors away quickly, so local concentrations of the chemical will be higher than the concentrations farther from the plant. Under windy conditions, the vapors will be carried away faster, reducing the local concentrations. The number of people may increase or decrease with distance from the facility. The location of the printing facility will also influence the exposure. If the location is known, the exposure assessor will use a computer program to determine weather patterns. The number of people around a known facility will be determined by using census data.

For our model facility, we assume a building height of three meters, and a width of 10 meters. This is a building approximately the size of a one-car garage. We then pick sample weather conditions to determine what the air concentration of a chemical will be at a set distance from the printing facility. San Bernardino is used because the weather conditions there will result in the highest average concentrations around the facility of any of the approximately 500 weather stations in the United States. The average concentrations around San Bernardino are within an order of magnitude (power of ten) of concentrations expected anywhere else in the country.   If the San Bernardino average concentration were estimated as $10 \ \mu g/m^3$, then the average concentration anywhere in the country would be greater than $1 \ \mu g/m^3$.

The model used is called Industrial Source Complex Long Term (ISCLT). It was developed as a regulatory model by the EPA's Office of Air and Radiation. The Office of Pollution Prevention and Toxics uses an implementation of ISCLT in the Graphical Exposure Modeling System (GEMS). Appendix B contains an example of an input file for this model. Except for items identified, the parameters entered are the regulatory defaults. The model will calculate more than one chemical at a time and is run in urban 3 mode. Also entered into the model is the decay rate of the chemical. To convert from the half-life of the chemical (given in the fate summaries in Chapter 2) to the decay rate in inverse seconds, divide 0.693 (the natural log of 2) by the half-life in seconds.

The amount released, given in this document in units of grams per second, is calculated in grams per second per meter squared. Since our model facility is 10 meters per side, or 100 meters square, the release is divided by 100.

In order to obtain the concentration at 100 meters, a special polar grid was entered. The ring distances specified were 100 meters, 200 meters, 300 meters, 400 meters, 500 meters, 600 meters, 700 meters, 800 meters, 900 meters and a kilometer. The air dispersion model calculates the average air concentrations of the chemical vapors in the specified sectors. The sectors are defined by the rings and the compass points, forming an arc-shaped area. There were three calculations per sector. The compass point with the highest concentration at 100 meters was then used to determine exposure. The location was at 90°, that is, east.

From the concentration in the air, the amount with which an individual may actually come in contact can be calculated by knowing the breathing rate. A moderately active adult breathes 20 m^3 per day. The formula for an annual dose is:

$$\text{Annual Dose} = \text{Concentration x Daily Inhalation Rate x Days per year}$$

where the concentration is in $\mu g/m^3$, and the breathing rate is in cubic meters per day. The potential dose normalized for body mass calculated per day for the entire lifetime, is called the Lifetime Average Daily Dose or LADD (Table 3-3). The formula for this dose rate is:

$$\text{LADD} = \frac{\text{Concentration x Daily Inhalation Rate x 0.001 mg/}\mu g}{\text{Average Body Weight}}$$

The average body weight used in this assessment is 70 kg (an average adult).   Since there is no ratio for the percentage of days spent breathing air containing evaporated blanket wash chemicals, this calculation assumes that a person will be breathing this concentration every day of their life.

Uncertainty

Within our scenario, there are specific parameters which affect final concentrations and therefore final exposures more than others.   Since we are using the estimates for comparison, the single most important factor is the amount of the substance released per formulation. This is true for both air and water.

Air releases have many factors which fold into the behavior of the chemical. A stronger fan will increase the number of people outside the facility who come in contact the chemical, because the chemical will stay concentrated farther. A higher temperature will cause the chemical to rise in the air.   The relative differences between these things is not as significant to the final concentration as is the amount released.

**Table 3-3. Single Facility 100 Meter Air Concentrations and Residential
Population Potential Dose Rates[1]**

Form. Number	Chemical Components	100 Meter Concentration ($\mu g/m^3$)	Annual Pot. Dose (mg/year)	LADD (mg/kg/day)
1	Fatty acid derivatives Alkoxylated alcohols	10 3	80 20	3×10^{-3} 8×10^{-4}
3	Hydrocarbons, petroleum distillates Fatty acid derivatives Hydrocarbons, aromatic Alkyl benzene sulfonates	4 4.2	30 28.7	1×10^{-3} 1.29×10^{-3}
4	Terpenes Ethoxylated nonylphenol	10	70	3×10^{-3}
5	Water Hydrocarbons, aromatic Ethylene glycol ethers Ethoxylated nonylphenol Alkyl benzene sulfonates Alkoxylated alcohols Alkali/salts	 4 2	 30 10	 1×10^{-3} 5×10^{-4}
6	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	 3 1	 20 7	 9×10^{-4} 3×10^{-4}
7	Terpenes Ethoxylated nonylphenol Alkoxylated alcohols	12	95	4.5×10^{-3}
8	Water Hydrocarbons, aromatic Propylene glycol ethers Alkyl benzene sulfonates Ethoxylated nonylphenol Alkoxylated alcohols Alkali/salts	 3 2	 20 20	 9×10^{-4} 6×10^{-4}
9	Fatty acid derivatives Water Ethoxylated nonylphenol			
10	Fatty acid derivatives Water			
11	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	 5 9×10^{-1}	 40 7	 1×10^{-3} 3×10^{-4}
12	Hydrocarbons, petroleum distillates	5.9	47	1.3×10^{-3}
14	Fatty acid derivatives Propylene glycol ethers	1	9	4×10^{-4}
16	Terpenes	12.5	100	4.6×10^{-3}

Form. Number	Chemical Components	100 Meter Concentration ($\mu g/m^3$)	Annual Pot. Dose (mg/year)	LADD (mg/kg/day)
17	Ethoxylated nonylphenol Glycols Fatty acid derivatives Alkali/salts Water	5×10^{-1}	4	1×10^{-4}
18	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Dibasic esters Esters/lactones Alkyl benzene sulfonates	4 9×10^{-1} 1.8 6×10^{-1}	30 7 12 4	1×10^{-3} 3×10^{-4} 6×10^{-4} 2×10^{-4}
19	Fatty acid derivatives Propylene glycol ethers	9	70	3×10^{-3}
20	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	2 1	10 9	5×10^{-4} 3×10^{-4}
21	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates Fatty acid derivatives	3 4	20 30	7×10^{-4} 1×10^{-3}
22	Fatty acid derivatives Hydrocarbons, aromatic	3	20	9×10^{-4}
23	Terpenes Nitrogen heterocyclics Alkoxylated alcohols	6 4 4	40 30 30	2×10^{-3} 1×10^{-3} 1×10^{-3}
24	Terpenes Ethylene glycol ethers Ethoxylated nonylphenol Alkyl benzene sulfonates Alkali/salts	2 6×10^{-1}	20 4	7×10^{-4} 2×10^{-4}
25	Terpenes Esters/lactones	12.3 6×10^{-1}	93 4	4.4×10^{-3} 2×10^{-4}
26	Fatty acid derivatives Esters/lactones			
27	Terpenes	21	140	6.3×10^{-3}
28	Hydrocarbons, petroleum distillates	10	70	3×10^{-3}
29	Fatty acid derivatives			
30	Hydrocarbons, aromatic Propylene glycol ethers	9 1	60 10	2×10^{-3} 4×10^{-4}
31	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates	2 10	10 70	5×10^{-4} 3×10^{-3}
32	Hydrocarbons, petroleum distillates	10	90	3×10^{-3}
33	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Propylene glycol ethers	3 3 6×10^{-1}	20 20 4	9×10^{-4} 9×10^{-4} 2×10^{-4}

Form. Number	Chemical Components	100 Meter Concentration (µg/m³)	Annual Pot. Dose (mg/year)	LADD (mg/kg/day)
34	Water Terpenes Hydrocarbons, petroleum distillates Alkoxylated alcohols Fatty acid derivatives	3 2	20 20	7×10^{-4} 6×10^{-4}
35	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic	2 10	10 70	5×10^{-4} 3×10^{-3}
36	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Propylene glycol ethers	2 1 6×10^{-1}	20 8 4	7×10^{-4} 3×10^{-4} 2×10^{-4}
37	Water Hydrocarbons, petroleum distillates Hydrocarbons, aromatic	12 5	80 40	4×10^{-3} 1×10^{-3}
38	Hydrocarbons, petroleum distillates Alkoxylated alcohols Fatty acid derivatives	8 2	60 20	2×10^{-3} 6×10^{-4}
39	Water Hydrocarbons, petroleum distillates Propylene glycol ethers Alkanolamines Ethylene glycol ethers	3 1 7×10^{-1}	20 10 5	7×10^{-4} 4×10^{-4} 2×10^{-4}
40	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates Fatty acid derivatives Ethoxylated nonylphenol	2 2	10 20	5×10^{-4} 6×10^{-4}

[1] A blank space in the table indicates that there were no air releases for the chemical because the chemical would not evaporate readily.

Regional Exposure: For the second approach, the overall general population exposure picture resulting from multiple printing facilities was sought. The total residential population exposed to blanket wash chemicals was not available, since the locations of all the lithography facilities across the country are not known. Instead, a single city was used and all known facilities within that city were modeled to provide a general idea of exposures that might result from cumulative releases. Denver was chosen as an example city (Table 3-4). Within the city limits of Denver, Dun and Bradstreet report 235 lithographers. The example assumes that all of the lithographers in Denver use each blanket wash formulation at the same time. The average concentration for the city of Denver is then calculated, using local weather data. The 1990 population for the city of Denver is approximately 470,000.

In this case, the model used is BOXMOD, also implemented in the Graphical Exposure Modeling System. It uses a parameter called the Time Constant to account for chemical degradation. The time constant is the inverse of the rate of decay used for the ISCLT model. This is also the half-life in air divided by 0.693. The other parameter needed to run the model is the size of the area being modeled. Denver is 277.13 square kilometers, or 16.65 kilometers on a side. An example of a BOXMOD run is located in Appendix B.

Table 3-4. Denver Average Air Concentrations and Residential Population Potential Dose Rates[1]

Form. Number	Chemical Components	100 Meter Concentration ($\mu g/m^3$)	Annual Pot. Dose (mg/year)	LADD (mg/kg/day)
1	Fatty acid derivatives Alkoxylated alcohols	1 4×10^{-1}	9 3	3×10^{-4} 1×10^{-4}
3	Hydrocarbons, petroleum distillates Fatty acid derivatives Hydrocarbons, aromatic Alkyl benzene sulfonates	6×10^{-1} 6.5×10^{-1}	4 5	2×10^{-4} 1.45×10^{-4}
4	Terpenes Ethoxylated nonylphenol	1	8	3×10^{-4}
5	Water Hydrocarbons, aromatic Ethylene glycol ethers Ethoxylated nonylphenol Alkyl benzene sulfonates Alkoxylated alcohols Alkali/salts	6×10^{-1} 2×10^{-1}	4 1	2×10^{-4} 6×10^{-5}
6	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	5×10^{-1} 2×10^{-1}	4 1	1×10^{-4} 6×10^{-5}
7	Terpenes Ethoxylated nonylphenol Alkoxylated alcohols	1.72	12.6	4.56×10^{-4}
8	Water Hydrocarbons, aromatic Propylene glycol ethers Alkyl benzene sulfonates Ethoxylated nonylphenol Alkoxylated alcohols Alkali/salts	5×10^{-1} 3×10^{-1}	4 2	1×10^{-4} 9×10^{-5}
9	Fatty acid derivatives Water Ethoxylated nonylphenol			
10	Fatty acid derivatives Water			
11	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	8×10^{-1} 1×10^{-1}	6 7×10^{-1}	2×10^{-4} 3×10^{-5}
12	Hydrocarbons, petroleum distillates	9×10^{-1}	6.7	2.3×10^{-4}
14	Fatty acid derivatives Propylene glycol ethers	2×10^{-1}	1	6×10^{-5}
16	Terpenes	1.89	13.3	5.2×10^{-4}

Form. Number	Chemical Components	100 Meter Concentration ($\mu g/m^3$)	Annual Pot. Dose (mg/year)	LADD (mg/kg/day)
17	Ethoxylated nonylphenol Glycols Fatty acid derivatives Alkali/salts Water	4×10^{-2}	3×10^{-1}	1×10^{-5}
18	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Dibasic esters Esters/lactones Alkyl benzene sulfonates	6×10^{-1} 1×10^{-1} 2.6×10^{-1} 8×10^{-2}	4 7×10^{-1} 2 6×10^{-1}	2×10^{-4} 3×10^{-5} 8×10^{-5} 2×10^{-5}
19	Fatty acid derivatives Propylene glycol ethers	1	9	4×10^{-4}
20	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	3×10^{-1} 2×10^{-1}	2 1	9×10^{-5} 6×10^{-5}
21	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates Fatty acid derivatives	4×10^{-1} 6×10^{-1}	3 4	1×10^{-4} 2×10^{-4}
22	Fatty acid derivatives Hydrocarbons, aromatic	5×10^{-1}	4	1×10^{-4}
23	Terpenes Nitrogen heterocyclics Alkoxylated alcohols	8×10^{-1} 5×10^{-1} 6×10^{-1}	6 4 4	2×10^{-4} 1×10^{-4} 2×10^{-4}
24	Terpenes Ethylene glycol ethers Ethoxylated nonylphenol Alkyl benzene sulfonates Alkali/salts	3×10^{-1} 8×10^{-2}	2 6×10^{-1}	9×10^{-5} 2×10^{-5}
25	Terpenes Esters/lactones	1.63 8×10^{-2}	12.4 6×10^{-1}	4.59×10^{-4} 2×10^{-5}
26	Fatty acid derivatives Esters/lactones			
27	Terpenes	3	23	7.9×10^{-4}
28	Hydrocarbons, petroleum distillates	2	10	5×10^{-4}
29	Fatty acid derivatives			
30	Hydrocarbons, aromatic Propylene glycol ethers	1 2×10^{-1}	9 1	4×10^{-4} 6×10^{-5}
31	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates	3×10^{-1} 2	2 10	9×10^{-5} 6×10^{-4}
32	Hydrocarbons, petroleum distillates	2	10	5×10^{-4}
33	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Propylene glycol ethers	5×10^{-1} 5×10^{-1} 8×10^{-2}	4 4 6×10^{-1}	1×10^{-4} 1×10^{-4} 2×10^{-5}

Form. Number	Chemical Components	100 Meter Concentration (µg/m³)	Annual Pot. Dose (mg/year)	LADD (mg/kg/day)
34	Water Terpenes Hydrocarbons, petroleum distillates Alkoxylated alcohols Fatty acid derivatives	3×10^{-1} 3×10^{-1}	2 2	9×10^{-5} 9×10^{-5}
35	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic	3×10^{-1} 2	2 10	9×10^{-5} 5×10^{-4}
36	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Propylene glycol ethers	4×10^{-1} 2×10^{-1} 8×10^{-2}	3 1 6×10^{-1}	1×10^{-4} 6×10^{-5} 2×10^{-5}
37	Water Hydrocarbons, petroleum distillates Hydrocarbons, aromatic	1.8 8×10^{-1}	14 6	6×10^{-4} 2×10^{-4}
38	Hydrocarbons, petroleum distillates Alkoxylated alcohols Fatty acid derivatives	1 3×10^{-1}	9 2	4×10^{-4} 9×10^{-5}
39	Water Hydrocarbons, petroleum distillates Propylene glycol ethers Alkanolamines Ethylene glycol ethers	4×10^{-1} 2×10^{-1} 9×10^{-2}	3 1 7×10^{-1}	1×10^{-4} 6×10^{-5} 3×10^{-5}
40	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates Fatty acid derivatives Ethoxylated nonylphenol	3×10^{-1} 3×10^{-1}	2 2	9×10^{-5} 9×10^{-5}

[1] A blank space in the table indicates that there were no releases to air because the chemical would not evaporate readily.

Surface Water

Releases to surface water are those releases discharged through a drain at a printing facility, or at a laundry facility laundering rags from the printing facility that end up going to public sewers or Publicly Owned Treatment Works (POTWs). This discharge is treated before being released. The effectiveness of the treatment determined so that the amount actually getting through to the receiving water body can be calculated. The receiving water will dilute the discharge from the POTW, and a stream concentration can be calculated using stream flow information. Stream in this context means the receiving body of water, and are creeks and rivers as well as streams.

Average stream concentrations are used to calculate average drinking water consumption. Many public water supplies are drawn from the local streams and rivers; the concentration in the stream is the concentration which people will ingest. People on average drink two liters of water a day. Remember that many commercially-prepared beverages are still made with local water at the bottling plant.

Since there are many chemicals which accumulate in living organisms (bioaccumulation), the amount of the chemical from eating fish living in the same streams and rivers is calculated. The ability of a chemical to bioaccumulate may be measured or estimated, and that property is called the bioaccumulation factor. For certain kinds of chemicals, food consumption may deliver very high doses because of the cumulative nature. We use the bioconcentration factor and the average amount of fish eaten per person per day to calculate an average amount of chemical ingested by people on a daily basis (Table 3-5).

The other issue for surface water is the effect that a chemical may have on aquatic organisms, from algae to fish. If the food chain is broken in a stream, the consequences are dire. No algae, no fish. A healthy stream with many organisms will have a better ability to handle chemical releases than one whose quality is already compromised. The organisms lower on the food chain, such as algae, tend to have shorter lives, making shorter exposure time periods more critical. Since concentrations will vary with the stream flow, there may be periods of lower flow conditions where the same amount released as on a regular flow situation will cause problems. We use historical stream data to try to predict how often this will happen. For lithographers, since most do not need to have their own wastewater permit and more typically send their water to the local treatment plant, we use the information for the wastewater treatment plants to calculate the concentrations.

Local Exposure: For the single facility impact to be calculated for a real facility, the stream to which the local POTW discharges should be known. Just as there are variations in facility sizes, there are variations in stream flows, and stream flows vary with time. The impact of this on this assessment is that more than one concentration needs to be calculated. Chronic effects, such as cancer, require average concentrations to be used. Since the average (mean) stream flows depends on what stream is being used, we select two averages to calculate - the average concentration for an mid-sized stream (50th percentile mean flow), and the average concentration for a small stream (10th percentile mean flow). For acute concerns and for ecological concerns, we calculated high concentrations which occur under low flow conditions. Specifically, low flow is the lowest flow that continues for seven consecutive days in ten years. However, we only calculate the low for small streams (10th percentile low flow).

The actual flows used in this assessment are 499 million liters per day for the 50th percentile harmonic mean flow, 66 million liters per day for 10th percentile mean flow, and 1 million liters per day for 10th percentile low flow.

Since an individual may ingest both drinking water and fish, there are multiple potential doses to evaluate.

To calculate stream concentration in µg/L, use the following formula:

$$\text{Stream Concentration} = \frac{\text{Release in kg/site/day x (1-Removal) x 1000}}{\text{Streamflow in million liters per day}}$$

or,

$$\text{Stream Concentration} = \frac{\text{Release after treatment in kg/site/day x 1000}}{\text{Streamflow in million liters per day}}$$

Because the flow data we use are measured by the U.S. Geological Survey (USGS) below any discharger on that segment of the stream (technically at the bottom of the reach), it already includes water from any POTW on that segment. For large streams this is not an important consideration, but for POTWs on small streams, it becomes contentious. A POTW with an internal plant flow of 10 million liters per day releasing to a stream which has a low flow of 10 million liters per day is not insignificant; it is all of the receiving stream's water.   Based on the data, there are a significant number of POTWs for which this appears to be the case.

To calculate how much a person will ingest through drinking water in mg per year, use the formula:

Yearly Potential Dose Rate = Stream concentration in µg per liter x 2 liters of water per day
x Days of release per year x 0.001

To calculate the potential amount taken through eating seafood in mg per year, use the following formula:

Yearly Potential Dose Rate = Stream concentration in µg per liter x Bioconcentration factor
x 16.9 grams of fish per day x Days of release per year x 10^{-6}

The formula above does not consider removal during drinking water treatment. Public drinking water treatment is designed primarily to prevent biological contamination of drinking water and does not necessarily remove chemicals from the water. For most chemicals, drinking water treatment is not an effective mechanism. An exception to this is where an activated charcoal filter is used, such as on a private residential tap, which will remove a significant portion of the organic chemicals in the water.

The bioconcentration factor is a chemical-specific property. It is calculated with the environmental fate properties. The chemicals are assumed to be released 250 days per year.

Cumulative releases to the same POTW may be estimated by counting the number of lithographers in an area and distributing the releases across all the POTWs in the area. We have to assume that the releases are for the same products, or very similar products. As for air, this cumulative number is expected to be far more significant than the amount for any single lithographer. Again, Denver is the city used as an example (Table 3-6). Releases from all of the 235 lithographers in the city of Denver are assumed to go from the Denver Metro Wastewater Reclamation District into the South Platte River. The concentrations are calculated for harmonic mean flow of 875 million liters per day - which is the average or typical flow for the river, and for the low flow of 590 million liters per day - the lowest flow for seven consecutive days in ten years. Downstream from the discharge are drinking water intakes for the City of Broomfield and the City of Thornton.

Uncertainty

Within our scenario, there are specific parameters which affect final concentrations and therefore final exposures more than others.   Since we are using the estimates for comparison, the single most important factor is the amount of the substance released per formulation. For water releases, the second most uncertain factor is the volume of water in the receiving stream, followed by the amount of substance removed in waste water treatment. In actuality, river flows vary continuously, so even a constant and steady flow of a specific chemical into the water will have variations in concentration. Some waste water treatment plants will remove more of a chemical than others, and even vary within the same plant at different times. The difference that this

Table 3-5. Stream Concentrations and Residential Population Potential Doses from Single Facility Blanket Wash Releases

Form. Number	Chemical Components	Daily Release[1] (kg/day)	Daily Release After POTW Treatment [1] (kg/day)	Stream concentrations[1] (mg/L)			Drinking Water Human Potential Dose Rates[2] (mg/year)		Fish Ingestion Human Potential Dose Rates[2] (mg/year)	
				50th %ile Mean flow	10th %ile Mean flow	10th %ile Low flow	50th %ile	10th %ile	50th %ile	10th %ile
1	Fatty acid derivatives Alkoxylated alcohols									
3	Hydrocarbons, petroleum distillates Fatty acid derivatives Hydrocarbons, aromatic Alkyl benzene sulfonates	6.1×10^{-1} 1.5×10^{-1}	3.6×10^{-2} 2.6×10^{-2}	7×10^{-5} 5×10^{-5}	6×10^{-4} 4×10^{-4}	4×10^{-2} 3×10^{-2}	4×10^{-2} 3×10^{2}	3×10^{-1} 2×10^{-1}	1×10^{2} 6×10^{-1}	1×10^{3} 4
4	Terpenes Ethoxylated nonylphenol[3]	1.56	8×10	2×10^{-4}	1.0×10^{-3}	8.0×10^{-2}	8×10^{-2}	6×10^{-1}		
5	Water Hydrocarbons, aromatic Ethylene glycol ethers Ethoxylated nonylphenol[3] Alkyl benzene sulfonates Alkoxylated alcohols Alkali/salts	2.0×10^{-1} 1.2×10^{-1} 6.0×10^{-2} 2.0×10^{-2}	1×10^{-2} 2.4×10^{-3} 5.9×10^{-2} 0	2×10^{-5} 5×10^{-6} 1×10^{-4} 0	2×10^{-4} 3.9×10^{-5} 9×10^{-4} 0	1.0×10^{-2} 2.6×10^{-3} 6×10^{-2} 0	1×10^{2} 2.6×10^{-3} 6×10^{-2} 0	8×10^{-2} 2.5×10^{-2} 5×10^{-1} 0	1×10^{-2} 9×10^{-2} 0	1×10^{-2} 7×10^{-1} 0
6	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	1.3 1.0×10^{-1}	7.9×10^{-2} 3.0×10^{-3}	2×10^{-4} 6×10^{-6}	1×10^{-3} 5×10^{-5}	8×10^{-2} 3×10^{-3}	8×10^{-2} 3×10^{-3}	6×10^{-1} 2×10^{-2}	3×10^{2} 0	2×10^{3} 0
7	Terpenes Ethoxylated nonylphenol[3] Alkoxylated alcohols	6.0×10^{-2} 6.0×10^{-2}	3×10^{-3} 9×10^{-3}	6×10^{-6} 2×10^{-5}	5×10^{-5} 1×10^{-4}	3×10^{-3} 9×10^{-3}	3×10^{-3} 9×10^{-3}	2×10^{-2} 7×10^{-2}	 0	 0
8	Water Hydrocarbons, aromatic Propylene glycol ethers Ethoxylated nonylphenol[3] Alkyl benzene sulfonates Alkoxylated alcohols Alkali/salts	1.7×10^{-1} 3.64×10^{-1} 5.2×10^{-2} 1.6×10^{-2}	9×10^{-3} 5.332×10^{-2} 5.1×10^{-2} 0	2×10^{-5} 1.11×10^{-4} 1×10^{-4} 0	1×10^{-4} 8.08×10^{-4} 8×10^{-4} 0	9.0×10^{-3} 4.95×10^{-2} 5×10^{-2} 0	9×10^{-3} 4.95×10^{-2} 5×10^{-2} 0	6×10^{-2} 3.7×10^{-1} 4×10^{-1} 0	1×10^{-2} 8×10^{-2} 0	9×10^{-2} 6×10^{-1} 0

Form. Number	Chemical Components	Daily Release[1] (kg/day)	Daily Release After POTW Treatment[1] (kg/day)	Stream concentrations[1] (mg/L) 50th %ile Mean flow	10th %ile Mean flow	10th %ile Low flow	Drinking Water Human Potential Dose Rates[2] (mg/year) 50th %ile	10th %ile	Fish Ingestion Human Potential Dose Rates[2] (mg/year) 50th %ile	10th %ile
9	Fatty acid derivatives	1.6	9.7×10^{-2}	2×10^{-4}	1×10^{-3}	1×10^{-1}	1×10^{-1}	7×10^{-1}	4×10^{2}	3×10^{3}
	Water									
	Ethoxylated nonylphenol[3]	6.0×10^{-2}	3×10^{-3}	6×10^{-6}	5×10^{-5}	3×10^{-3}	3×10^{-3}	2×10^{-2}		
10	Fatty acid derivatives	5.6×10^{-1}	3.4×10^{-2}	7×10^{-5}	5×10^{-4}	3×10^{-2}	3×10^{-2}	3×10^{-1}	1×10^{2}	1×10^{3}
	Water									
11	Fatty acid derivatives	1.0	6.0×10^{-2}	1×10^{-4}	9×10^{-4}	6×10^{-2}	6×10^{-2}	5×10^{-1}	2×10^{2}	2×10^{2}
	Hydrocarbons, petroleum distillates									
	Hydrocarbons, aromatic									
	Alkyl benzene sulfonates	9.2×10^{-2}	1.6×10^{-2}	3×10^{-5}	2×10^{-4}	2×10^{-2}	2×10^{-2}	1×10^{-1}	0	0
12	Hydrocarbons, petroleum distillates									
14	Fatty acid derivatives	2.2×10^{-1}	1.3×10^{-2}	3×10^{-5}	2×10^{-4}	1×10^{-2}	1×10^{-2}	1×10^{-1}	5×10^{1}	4×10^{2}
	Propylene glycol ethers									
16	Terpenes									
17	Ethoxylated nonylphenol[3]	4.4×10^{-2}	2×10^{-3}	4×10^{-6}	3×10^{-5}	2×10^{-3}	2×10^{-3}	2×10^{-2}		
	Glycols									
	Fatty acid derivatives	2.0×10^{-2}	1.2×10^{-3}	2×10^{-6}	2×10^{-5}	1×10^{-3}	1×10^{-3}	9×10^{-3}	5	3
	Alkali/salts	1.2×10^{-2}								
	Water									
18	Fatty acid derivatives	9.0×10^{-1}	5.4×10^{-2}	1×10^{-4}	8×10^{-4}	5×10^{-2}	5×10^{-2}	4×10^{-1}	2×10^{2}	2×10^{3}
	Hydrocarbons, petroleum distillates									
	Hydrocarbons, aromatic									
	Dibasic esters									
	Esters/lactones									
	Alkyl benzene sulfonates	9.2×10^{-2}	1.6×10^{-2}	3×10^{-5}	2×10^{-4}	2×10^{-2}	2×10^{-2}	1×10^{-1}	0	0
19	Fatty acid derivatives	7.3×10^{-1}	4.4×10^{-2}	9×10^{-5}	7×10^{-4}	4×10^{-2}	4×10^{-2}	3×10^{-1}	2×10^{2}	1×10^{3}
	Propylene glycol ethers									
20	Hydrocarbons, petroleum distillates									
	Hydrocarbons, aromatic									
	Alkyl benzene sulfonates	1.0×10	3.9×10^{-2}	8×10^{-5}	6×10^{-4}	4×10^{-2}	4×10^{-2}	3×10^{-1}	0	0
21	Hydrocarbons, aromatic									
	Hydrocarbons, petroleum distillates									
	Fatty acid derivatives	1.0	1.0×10	2×10^{-5}	2×10^{-4}	1×10^{-2}	1×10^{-2}	8×10^{-2}	4×10^{1}	3×10^{2}

Form. Number	Chemical Components	Daily Release[1] (kg/day)	Daily Release[1] After POTW Treatment (kg/day)	Stream concentrations[1] (mg/L)			Drinking Water Human Potential Dose Rates[2] (mg/year)		Fish Ingestion Human Potential Dose Rates[2] (mg/year)	
				50th %ile Mean flow	10th %ile Mean flow	10th %ile Low flow	50th %ile	10th %ile	50th %ile	10th %ile
22	Fatty acid derivatives Hydrocarbons, aromatic	1.2	6.9×10	$1^2 \times 10^{-4}$	1×10^{-3}	7×10^{-2}	7×10^{-2}	5×10^2	3×10^2	2×10^3
23	Terpenes Nitrogen heterocyclics Alkoxylated alcohols									
24	Terpenes Ethylene glycol ethers Ethoxylated nonylphenol[3] Alkyl benzene sulfonates Alkali/salts	9.2×10^{-2} 1.4×10^{-1} 9.2×10^{-2}	5×10^{-3} 4.2×10^{-3} 1.6×10^{-2}	9×10^{-6} 8×10^{-6} 3×10^{-5}	7×10^{-5} 6×10^{-5} 2×10^{-4}	5×10^{-3} 4×10^{-3} 2×10^{-2}	5×10^{-3} 4×10^{-3} 2×10^{-2}	4×10^{-2} 3×10^{-2} 1×10^{-1}	0 0	0 0
25	Terpenes Esters/lactones									
26	Fatty acid derivatives Esters/lactones	6.1 1.03×10^{-1}	1.241×10^{-1} 4.1×10^{-3}	2.08×10^{-4} 8×10^{-6}	2.06×10^{-3} 6×10^{-5}	1.04×10^{-1} 4×10^{-3}	1.04×10^{-1} 4×10^{-3}	9.3×10^{-1} 3×10^{-2}	5.006×10^2 0	3.005×10^3 0
27	Terpenes									
28	Hydrocarbons, petroleum distillates									
29	Fatty acid derivatives	2.1	1.3×10^{-1}	3×10^{-4}	2×10^{-3}	1×10^{-1}	1×10^{-1}	1	5×10^2	4×10^3
30	Hydrocarbons, aromatic Propylene glycol ethers									
31	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates									
32	Hydrocarbons, petroleum distillates									
33	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Propylene glycol ethers									
34	Water Terpenes Hydrocarbons, petroleum distillates Alkoxylated alcohols Fatty acid derivatives	1.7×10^{-1} 1.7×10^{-1}	2.9×10^{-2} 1.7×10^{-2}	6×10^{-5} 3×10^{-5}	4×10^{-4} 3×10^{-4}	3×10^{-2} 2×10^{-2}	3×10^{-2} 2×10^{-2}	2×10^{-1} 1×10^{-1}	0 2×10^{-2}	0 2×10^{-1}

Form. Number	Chemical Components	Daily Release[1] (kg/day)	Daily Release After POTW Treatment[1] (kg/day)	Stream concentrations[1] (mg/L)			Drinking Water Human Potential Dose Rates[2] (mg/year)		Fish Ingestion Human Potential Dose Rates[2] (mg/year)	
				50th %ile Mean flow	10th %ile Mean flow	10th %ile Low flow	50th %ile	10th %ile	50th %ile	10th %ile
35	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic									
36	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Propylene glycol ethers	1.5	9.0×10^{-2}	2×10^{-4}	1×10^{-3}	9×10^{-2}	9×10^{-2}	7×10^{-1}	3×10^{2}	3×10^{3}
37	D. I. Water Hydrocarbons, petroleum distillates Hydrocarbons, aromatic									
38	Hydrocarbons, petroleum distillates Alkoxylated alcohols Fatty acid derivatives									
39	Water Hydrocarbons, petroleum distillates Propylene glycol ethers Alkanolamines Ethylene glycol ethers	6.8×10^{-2}	1.2×10^{-2}	2×10^{-5}	2×10^{-4}	1×10^{-2}	1×10^{-2}	9×10^{-2}	0	0
40	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates Fatty acid derivatives Ethoxylated nonylphenol[3]	1.4 8.8×10^{-2}	0 4×10^{-3}	0 9×10^{-6}	0 7×10^{-5}	0 4×10^{-3}	0 4×10^{-3}	0 3×10^{-2}	0	0

[1] A blank space in these columns indicates that there were no releases to water expected for this chemical in this formulation.

[2] A blank in the drinking water columns of this table indicates that there are no exposures expected from this chemical due to people drinking water. This may be due to either no releases to water expected, or the chemical may be completely removed during wastewater treatment, and therefore, is not expected to be released to the stream or river from the POTW. An additional blank in the Fish Ingestion columns means that a bioaccumulation factor was not available for this chemical.

[3] Based on testing data (Weeks, A.J. et al. 1996. *Proceedings of the CESIO 4th World Surfactants Congress, Barcelona, Spain.* Brussels, Belgium: European Committee on Surfactants and Detergents, pp. 276-291.), the original estimate of POTW removal has been changed from 100% reported in the draft document to 95% in the final report. This revision results in increased estimates of the releases from POTWs to surface waters of ethoxylated nonylphenols. When the releases to surface water are compared with the concern concentration set at the default value of 0.001 mg/L, the formulations containing ethoxylated nonylphenols (formulations 4, 5, 7, 8, 9, 17, 24, and 40) present concerns to aquatic species that were not reported in the draft CTSA.

Table 3-6. Stream Concentrations and Residential Population Potential Dose Rates from Denver Lithography Blanket Wash Releases

Form. No.	Chemical Components	Expected Total Release for Denver, CO (kg/day)[1]	After Treatment Total Release for Denver, CO (kg/day)[1]	Stream Concentration South Platte River (mg/L)		Human Potential Dose Rates (mg/year)[2]	
				Mean Flow	Low Flow	From Water	From Fish Ingestion
1	Fatty acid derivatives Alkoxylated alcohols						
3	Hydrocarbons, petroleum distillates Fatty acid derivatives Hydrocarbons, aromatic Alkyl benzene sulfonates	1.4×10^2 36	8.6 6.1	1×10^{-2} 7×10^{-3}	1×10^{-2} 1×10^{-2}	5 3	2×10^4 80
4	Terpenes Ethoxylated nonylphenol[3]	73	3.7	4×10^{-3}	6×10^{-3}	2	
5	Water Hydrocarbons, aromatic Ethylene glycol ethers Ethoxylated nonylphenol[3] Alkyl benzene sulfonates Alkoxylated alcohols Alkali/salts	47 28 14 4.7	2.4 5.6×10^{-1} 14 0.0	3×10^{-3} 7×10^{-4} 2×10^{-2} 0	4×10^{-3} 9×10^{-4} 2×10^{-2} 0	1 2.8×10^{-1} 8 0	2 10
6	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	3.1×10^2 24	19 7.1×10^{-1}	2×10^{-2} 8×10^{-4}	3×10^{-2} 1×10^{-3}	10 4×10^{-1}	4×10^4
7	Terpenes Ethoxylated nonylphenol[3] Alkoxylated alcohols	14 14	0.7 2.1	8×10^{-4} 2×10^{-3}	1×10^{-3} 4×10^{-3}	0.4 1	
8	Water Hydrocarbons, aromatic Propylene glycol ethers Alkyl benzene sulfonates Ethoxylated nonylphenol[3] Alkoxylated alcohols Alkali/salts	85 40 12 3.8	12.22 2.0 12 0.0	1.2×10^{-2} 2×10^{-3} 1×10^{-2} 0	2.4×10^{-2} 3×10^{-3} 2×10^{-2} 0	7.07 1 7 0	2 10
9	Fatty acid derivatives Water Ethoxylated nonylphenol[3]	3.8×10^2 14	23 0.7	3×10^{-2} 8×10^{-4}	4×10^{-2} 1×10^{-3}	10 4	5×10^4
10	Fatty acid derivatives Water	1.3×10^2	7.9	9×10^{-3}	1×10^{-2}	5	2×10^4
11	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	2.3×10^2 22	14 3.7	2×10^{-2} 4×10^{-3}	2×10^{-2} 6×10^{-3}	8 2	3×10^4
12	Hydrocarbons, petroleum distillates						
14	Fatty acid derivatives Propylene glycol ethers	51	3.0	3×10^{-3}	5×10^{-3}	2	7×10^3
16	Terpenes						

Form. No.	Chemical Components	Expected Total Release for Denver, CO (kg/day)[1]	After Treatment Total Release for Denver, CO (kg/day)[1]	Stream Concentration South Platte River (mg/L)		Human Potential Dose Rates (mg/year)[2]	
				Mean Flow	Low Flow	From Water	From Fish Ingestion
17	Ethoxylated nonylphenol[3] Glycols Fatty acid derivatives Alkali/salts Water	10 4.7	0.5 2.8×10^{-1}	6×10^{-4} 3×10^{-4}	8×10^{-4} 5×10^{-4}	0.3 2×10^{-1}	 6×10^{2}
18	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Dibasic esters Esters/lactones Alkyl benzene sulfonates	2.1×10^{2} 22	13 3.7	1×10^{-2} 4×10^{-3}	2×10^{-2} 6×10^{-3}	7 2	3×10^{4}
19	Fatty acid derivatives Propylene glycol ethers	1.7×10^{2}	10	1×10^{-2}	2×10^{-2}	6	2×10^{4}
20	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Alkyl benzene sulfonates	24	9.2	1×10^{-2}	2×10^{-2}	5	
21	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates Fatty acid derivatives	2.4×10^{2}	2.4	3×10^{-3}	4×10^{-3}	1	6×10^{3}
22	Fatty acid derivatives Hydrocarbons, aromatic	2.7×10^{2}	16	2×10^{-2}	3×10^{-2}	9	4×10^{4}
23	Terpenes Nitrogen heterocyclics Alkoxylated alcohols						
24	Terpenes Ethylene glycol ethers Ethoxylated nonylphenol[3] Alkyl benzene sulfonates Alkali/salts	22 33 22	1.1 9.9×10^{-1} 3.7	1×10^{-3} 1×10^{-3} 4×10^{-3}	2×10^{-3} 2×10^{-3} 6×10^{-3}	6×10^{-1} 6×10^{-1} 2	
25	Terpenes Esters/lactones						
26	Fatty acid derivatives Esters/lactones	5.66×10^{2} 2.36×10^{2}	2.896×10^{1} 9.6×10^{-1}	3.1×10^{-2} 1×10^{-3}	5.2×10^{-2} 2×10^{-3}	20.5 5×10^{-1}	6.008×10^{4} 0
27	Terpenes						
28	Hydrocarbons, petroleum distillates						
29	Fatty acid derivatives	5.0×10^{2}	30	3×10^{-2}	5×10^{-2}	20	6×10^{4}
30	Hydrocarbons, aromatic Propylene glycol ethers						
31	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates						
32	Hydrocarbons, petroleum distillates						
33	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Propylene glycol ethers						

Form. No.	Chemical Components	Expected Total Release for Denver, CO (kg/day)[1]	After Treatment Total Release for Denver, CO (kg/day)[1]	Stream Concentration South Platte River (mg/L)		Human Potential Dose Rates (mg/year)[2]	
				Mean Flow	Low Flow	From Water	From Fish Ingestion
34	Water Terpenes Hydrocarbons, petroleum distillates Alkoxylated alcohols Fatty acid derivatives	39 39	6.7 3.9	8×10^{-3} 5×10^{-3}	1×10^{-2} 7×10^{-3}	4 2	3
35	Hydrocarbons, petroleum distillates Hydrocarbons, aromatic						
36	Fatty acid derivatives Hydrocarbons, petroleum distillates Hydrocarbons, aromatic Propylene glycol ethers	3.5×10^{2}	21	2×10^{-2}	4×10^{-2}	10	5×10^{4}
37	Water Hydrocarbons, petroleum distillates Hydrocarbons, aromatic						
38	Hydrocarbons, petroleum distillates Alkoxylated alcohols Fatty acid derivatives						
39	Water Hydrocarbons, petroleum distillates Propylene glycol ethers Alkanolamines Ethylene glycol ethers	16	2.7	3×10^{-3}	5×10^{-3}	2	
40	Hydrocarbons, aromatic Hydrocarbons, petroleum distillates Fatty acid derivatives Ethoxylated nonylphenol[3]	3.3×10^{2} 21	0.0 1.1×10^{-3}	0 1.2×10^{-3}	0 1.9×10^{-3}	0 0.6	0

[1] A blank space in these columns indicates that there were no releases to water expected for this chemical in this formulation.

[2] A blank in the drinking water columns of this table indicates that there are no exposures expected from this chemical due to people drinking water. This may be due to either no releases to water expected, or the chemical may be completely removed during wastewater treatment, and therefore, is not expected to be released to the stream or river from the POTW. An additional blank in the Fish Ingestion columns means that a bioaccumulation factor was not available for this chemical.

[3] Based on testing data (Weeks, J.A. et al. 1996. *Proceedings of the CESIO 4th World Surfactants Congress, Barcelona, Spain.* Brussels, Belgium: European Committee on Surfactants and Detergents, pp. 276-291.), the original estimate of POTW removal has been changed from 100% reported in the draft document to 95% in the final report. This revision results in increased estimates of the releases from POTWs to surface waters of ethoxylated nonylphenols. When the releases to surface water are compared with the concern concentration set at the default value of 0.001 mg/L, the formulations containing ethoxylated nonylphenols (formulations 4, 5, 7, 8, 9, 17, 24, and 40) present concerns to aquatic species that were not reported in the draft CTSA.

makes in the final concentration is not as significant as the volume of the chemical released, i.e. the difference between fifty percent and sixty percent removal of a chemical.

Septic Systems

When examining the business census data for lithographers and the EPA's data for waste water treatment facilities, it was noted that there are counties which do not have any POTWs. While some of the Agency's data is probably in error, there are still a significant minority of lithographers who do not appear to release water to a waste water treatment plant. These printers are assumed to release to septic systems or have no water releases at all. The releases of this type are not modeled in this assessment. Some general guidelines may be used to determine if there will be exposure to any of the blanket wash chemicals from septic system seepage. Each chemical will have an estimated potential migration to ground water, usually used for landfill assessments. This can be directly applied to septic systems, because the potential to migrate to ground water will be the same. Of course the individual characteristics of the system will determine the actual speed that each chemical travels into the ground water. If the septic system is relatively leaky, and the ground water table is relatively high, the time that a chemical takes to get into the ground water will be shorter than for a septic system which is well sealed and where the ground water table is low.

Landfill

Our usual techniques for estimating cumulative exposures from landfill releases are not applicable to printing. For large-scale industrial processes, we assume that one facility sends waste to a landfill via a waste handler. For the printing industry, it is not reasonable to simplify the situation to that extent. A lack of data limits the determination of exposures. For instance, we do not know how many printers are sending what types of wastes to any given landfill. Some printers send part of their wastes to a hazardous waste handler, and another portion to the county landfill. For these reasons, although the exposures from landfill releases may be significant, we cannot calculate exposures from landfill seepage and migration into ground water. However, we can give the expected fate for the chemical in the landfill - will the chemical migrate to ground water rapidly, moderately or negligibly.

3.4 RISK CHARACTERIZATION

3.4.1 Background

Assessment of the human health risks presented by chemical substances includes the following components of analysis:

1) Hazard Identification is the process of determining whether exposure to a chemical can cause an adverse health effect and whether the adverse health effect is likely to occur in humans.

2) Dose-response Assessment is the process of defining the relationship between the dose of a chemical received and the incidence of adverse health effects in the exposed population. From the quantitative dose-response relationship, toxicity values are derived that are used in the risk characterization step to estimate the likelihood of adverse effects occurring in humans at different exposure levels.

3) Exposure Assessment identifies populations exposed to a chemical, describes their composition and size, and presents the types, magnitudes, frequencies, and durations of exposure to the chemical.